

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

Name: Spearfish Creek Watershed

County: Lawrence

Spearfish Creek watershed and Cleopatra Creek, a tributary to Spearfish Creek (Figure 1), were surveyed during 2007 to monitor fish populations and assess impacts of prolonged drought on the fishery. Brown trout *Salmo trutta*, rainbow trout *Oncorhynchus mykiss*, and brook trout *Salvelinus fontinalis* were documented in Spearfish Creek. The majority of Spearfish Creek and its tributaries are managed under standard regulations with a daily limit of five trout (in any combination) with one allowed 14 inches or longer. A one-mile reach of Spearfish Creek from the Maurice Intake upstream to the Hydro #2 building is currently managed with catch and release regulations for rainbow trout. Other trout species may be harvested according to standard regulations. This reach of Spearfish Creek is unique in that it contains the only naturally reproducing rainbow trout population in the Black Hills capable of maintaining a Class I rainbow trout ($> 25 \text{ fish} \geq 200 \text{ mm} / \text{surface acre}$) fishery.

Methods

Three 100 m reaches in Spearfish Creek and one 100 m reach in Cleopatra Creek (Figures 2 and 3) were surveyed during September under base flow conditions and prior to the fall spawning of brown and brook trout. Conclusions about the status of fish populations based on these samplings are tenuous at best due to the relatively small number of sample sites. As a result of the small sample size, discussion of the status of fish populations will pertain only to the individual sites.

Despite the lack of statistical rigor, efforts were made to ensure the required assumptions 1) the population is static and 2) number of fish was recorded properly were met (Guy and Brown 2007). Block nets at the upstream and downstream boundaries were used to prevent fish from emigrating or immigrating within the sample site. Three passes were made with one or two backpack electrofishing units. Captured fish were anesthetized with carbon dioxide, measured to the nearest millimeter, weighed to the nearest gram and returned to the stream. After 50 individual lengths and weights were collected from small fish ($< 100\text{mm}$) of a specific species, bulk counts were then collected to expedite data collection. A three-pass depletion estimate was used to estimate the number of fish within the sample reach (Guy and Brown 2007). Estimated numbers of fish within reaches were averaged to yield an estimate of number of fish per 100 m throughout the creek.

In addition to fish data, pH, temperature, and specific conductance were measured and recorded. Additionally, stream widths were measured every 10 m and averaged to obtain an estimate of total area sampled.

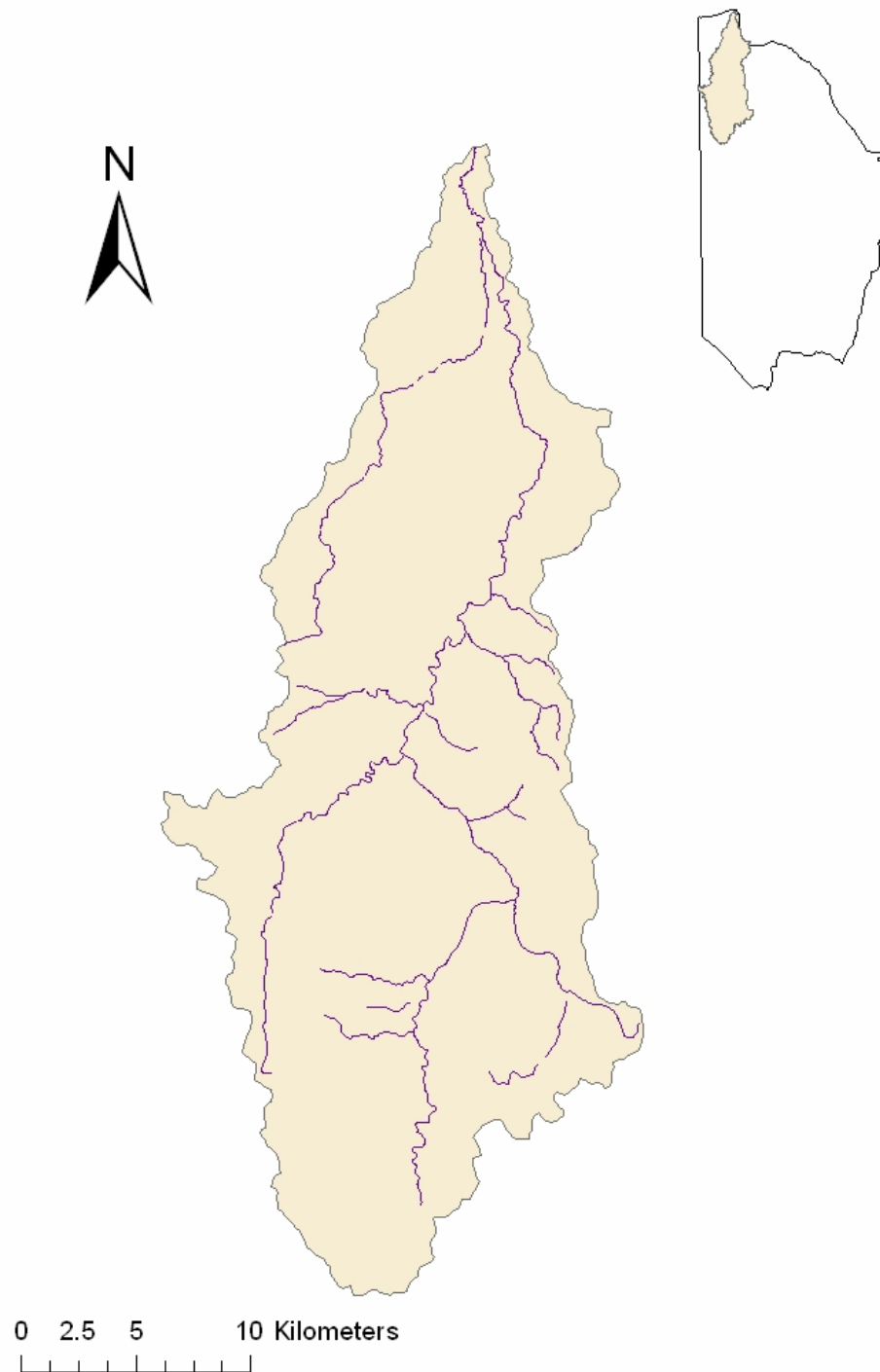


Figure 1. Map of Spearfish Creek Watershed and its location within the Black Hills Trout Management Area.



Figure 2. Sample site number 5 location (denoted by a star) in Spearfish Creek within the city of Spearfish.

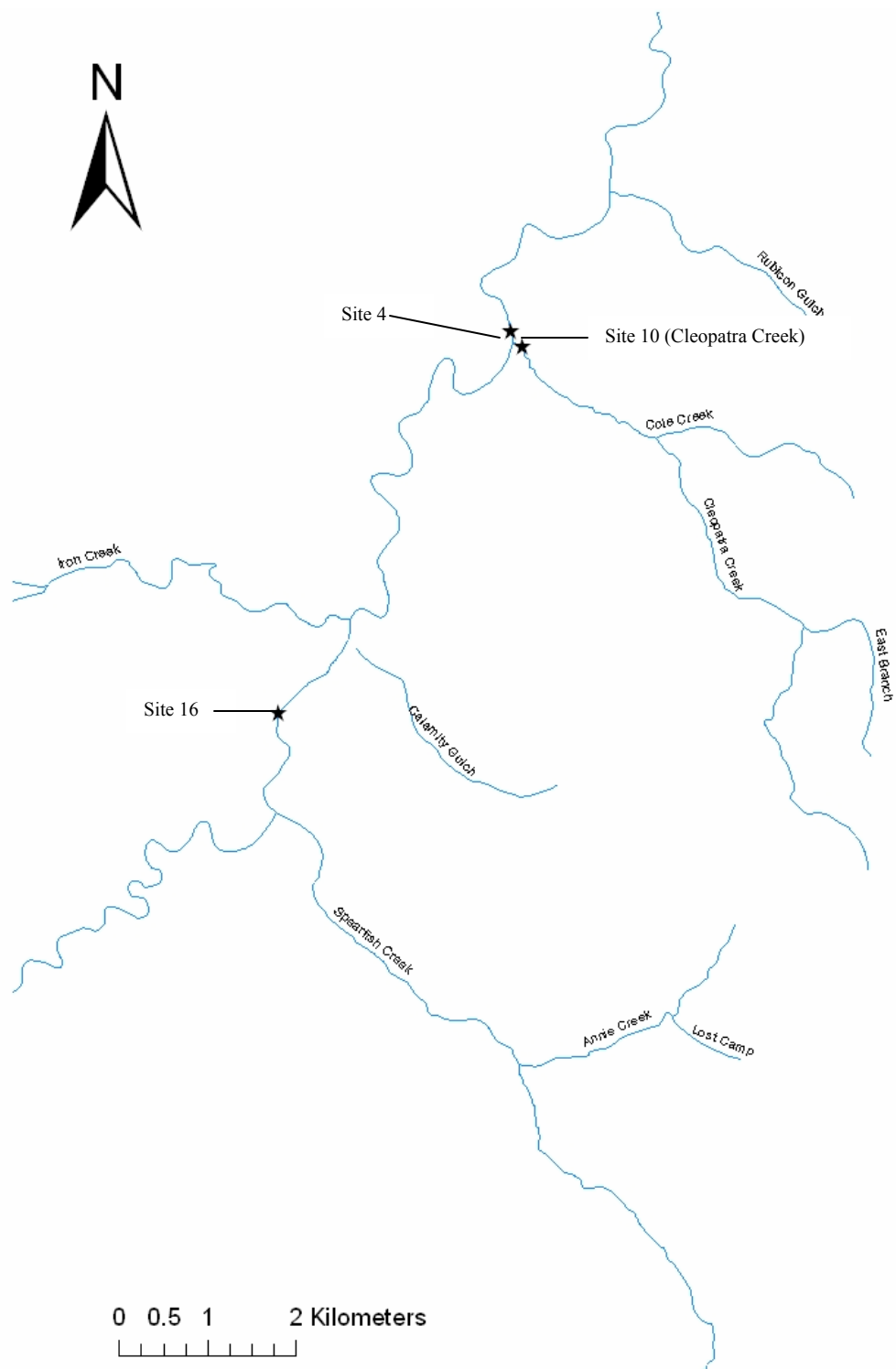


Figure 3. Locations of sample sites (denoted by stars) within Spearfish Creek and Cleopatra Creek above the city of Spearfish.

Results and Discussion

Spearfish Creek

Sampling in 2007 captured three species within Spearfish Creek. Species sampled included brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), and brook trout (*Salvelinus fontinalis*). Brown trout were captured in all sample reaches, but rainbow and brook trout were only sampled in the reach below the confluence with Cleopatra Creek.

Site 16 is the most upstream of the sample sites (Figure 3). Sampling in 2007 resulted in only brown trout being captured. However, two juvenile rainbow trout and one juvenile brook trout (< 200 mm) were sampled in this reach in 2006. Therefore, a small number of rainbow brook trout may inhabit this section of stream but occur in densities too low to be detected in this sampling.

Site 16 had the highest number of adult brown trout per 100 m (75) and the second highest number per acre (363) of the three Spearfish Creek sample sites. With 363 brown trout per acre, this section of Spearfish Creek is classified a Class I brown trout fishery. Abundance of juvenile brown trout was highest in site 16 (288 per 100 m) indicating this section may contain spawning and/or nursery habitat important to brown trout.

Trends in brown trout abundance indicated an increase in numbers of both juvenile and adult trout in site 16 (Figure 4). While no sampling occurred between 1998 and 2004, the population appeared to be fairly static during this time period. However, between 2004 and 2005 there is a dramatic increase in the number of juvenile brown trout. The most likely explanation for this increase is the additional water contribution by Little Spearfish Creek. Beginning in late fall of 2003, Little Spearfish Creek began contributing 15-17 cfs of water to Spearfish Creek (Ron Koth, SDGF&P personal communication). This additional water likely improved and created spawning habitat resulting in increased spawning success by brown trout in this section of Spearfish Creek. The increased spawning success may explain the general trend of increased abundance of adult fish between 2005 and 2007.

Site 4 was located approximately 6 stream kilometers downstream of site 16 and is in the section of stream managed under catch-and-release regulations for rainbow trout (Figure 3). Site 4 was the only sample site where brook and rainbow trout were sampled in addition to brown trout. Occurrence of rainbow and brook trout in this sample reach is probably due to the close proximity to Cleopatra Creek. A recent radio telemetry study indicated that Cleopatra Creek may be an important spawning and nursery tributary for rainbow trout (South Dakota Game, Fish, and Parks unpublished data). Sampling in 2007 within Cleopatra Creek indicated relatively high abundances of juvenile rainbow and brook trout in this stream (South Dakota Game, Fish, and Parks, this report). Therefore, the presence of juvenile rainbow and brook trout in this reach of Spearfish Creek is probably the result of escapement from Cleopatra Creek. Brook trout however, occurred

in low abundances with only four juveniles and no adults sampled. Therefore, no more discussion will be given to brook trout within Spearfish Creek.

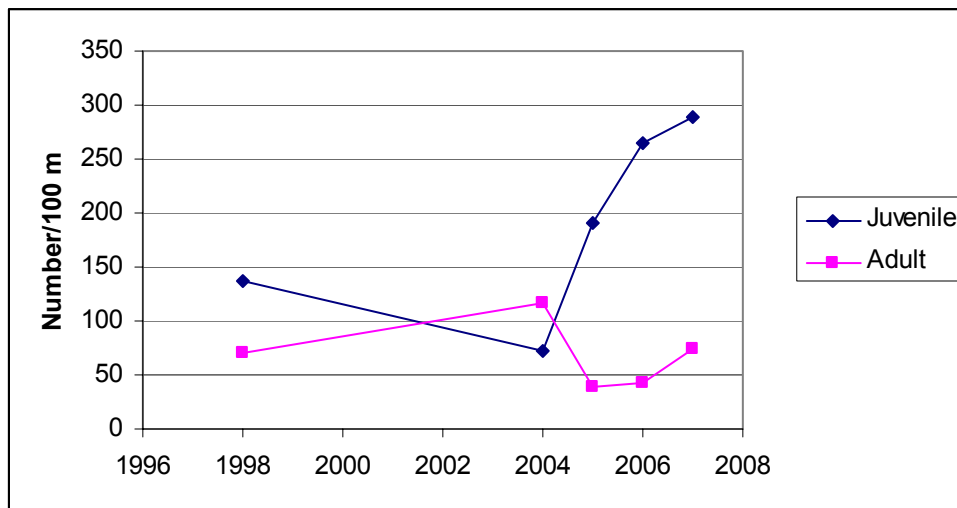


Figure 4. Trends in abundance of juvenile and adult brown trout for site 16 within Spearfish Creek.

Site 4 had the lowest number of adult brown trout per 100m (35) and number of adult brown trout per acre (155). This is likely a result of interspecies competition with rainbow trout that are present within this reach. There were 20 adult rainbow trout per 100 m and 89 per acre. If brown and rainbow trout are considered together, densities of trout in this reach more closely resembles that of densities of brown trout in the other two reaches sampled in Spearfish Creek. This section of Spearfish Creek is unique in that it is classified as a Class I rainbow trout fishery and a Class I brown trout fishery. No other reaches in any stream sampled in 2007 within the Black Hills have this distinction.

Trends in adult brown trout abundance indicated a decline in numbers from 2001 to 2004 with numbers leveling off between 2004 and 2007 (Figure 5). Numbers of juvenile brown trout display more annual variability but exhibit an overall decline beginning in 2000. A major contributing factor to this decline is likely the prolonged drought in the Black Hills and the associated reduction in stream flow. Aside from a few large precipitation events, stream flow remains relatively constant throughout the year in Spearfish Creek. Examination of mean annual flow illustrates the effects drought has had on discharge within Spearfish Creek (Figure 6). This decreased flow has likely resulted in a reduction in the amount of suitable habitat reducing available resources for trout (i.e., resting habitat, cover, and available forage) thus reducing carrying capacity.

Adult rainbow trout exhibited a decline in abundance similar to that of brown trout (Figure 7). However, rainbow trout abundance has not leveled off and actually increased between 2006 and 2007. Declines in rainbow trout are likely do to the same reason discussed above for brown trout.

Juvenile rainbow trout experienced a 14 fold increase from 2002 to 2006 (Figure 7). This increase may be a result of juvenile rainbow trout emigrating from Cleopatra Creek. Do to the prolonged drought, water levels in Cleopatra Creek may no longer be sufficient to create required nursery habitat thus forcing the juvenile rainbow trout to move downstream into Spearfish Creek. Between 2006 and 2007 numbers of juvenile rainbow trout dropped considerably. The most likely explanation for this decline is occurrence of a near 100 year runoff event in early June of 2007. High flows during this time probably resulted in a large number of juvenile trout being washed downstream. However, this flow event may have a positive impact in the long term by breaking up the calcium carbonate the armors the substrate of Spearfish Creek. With more substrate available for spawning, there may be an increase in numbers of juvenile rainbow trout in the next year.

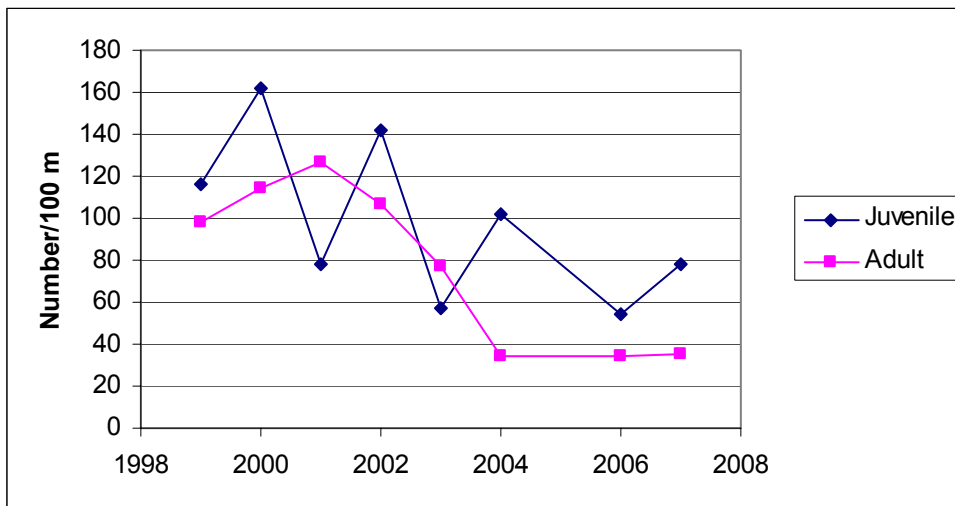


Figure 5. Trends in number of juvenile and adult brown trout per 100 m within site 4 in Spearfish Creek.

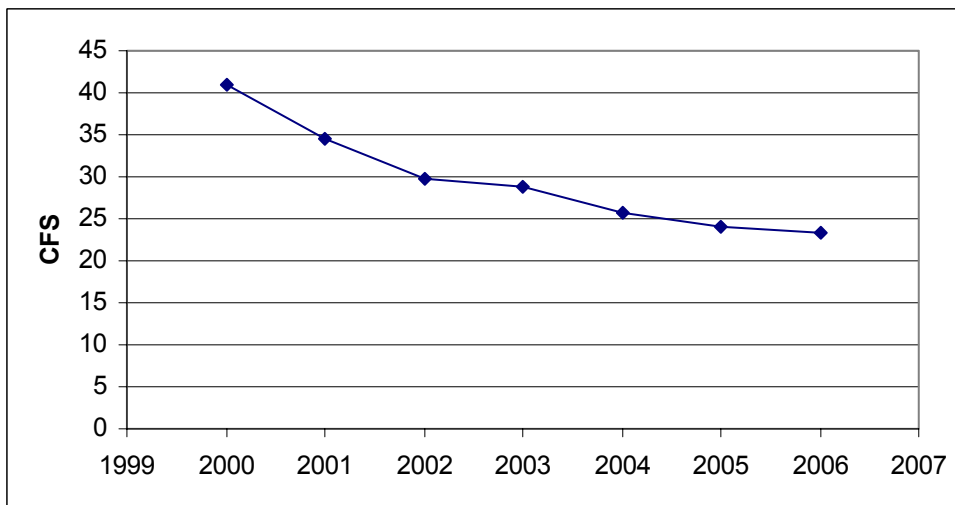


Figure 6. Mean annual discharge for Spearfish Creek constructed from flow data collected at USGS gauging station in Spearfish Creek.

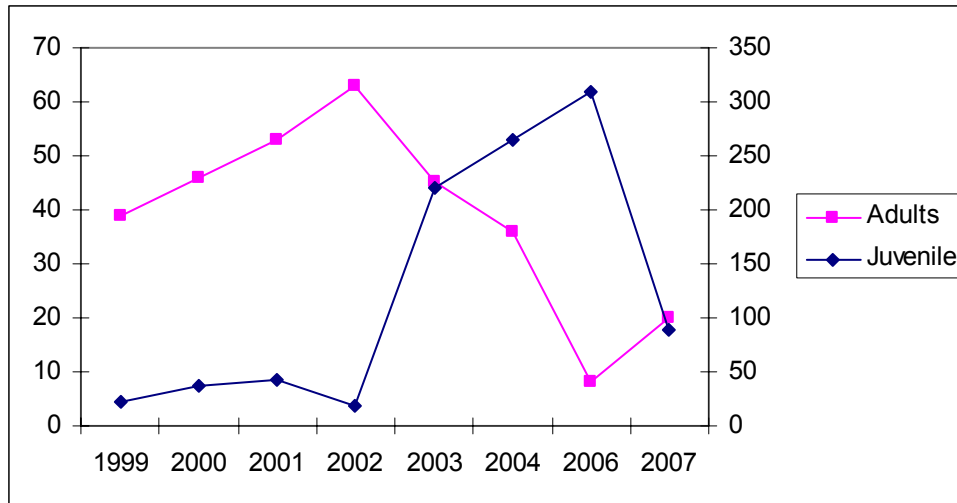


Figure 7. Trends in number of juvenile and adult rainbow trout per 100 m within site 4 in Spearfish Creek.

Site 5 is the most downstream sample reach and is located within the town of Spearfish (Figure 2). Brown trout was the only species captured in this site with the last rainbow trout sampled in this reach being a single juvenile in 1987.

This reach of Spearfish Creek had the second highest number of adult brown trout per 100 m (66) and the highest number per acre (390) resulting in this section also being classified as a class I brown trout fishery. This section had the lowest number of juvenile brown trout per 100 m (59). Site 5 was the only reach where adults occurred in a higher abundance than juveniles. Reasons for this are unknown but may be a factor of the habitat that is available in this reach.

Trends in abundances of adult and juvenile brown trout are similar to that of brown and rainbow trout in site 4 (Figure 8). However, numbers are higher in this section of stream probably the result of the absence of rainbow trout. The same factors are probably at work in this section of stream as well resulting in declines of adult brown trout. One difference is the apparent increase in juvenile brown trout between 2004 and 2006. The reason for this increase is not clear, but the subsequent decline between 2006 and 2007 may be the result of the high flow event in June of 2007.

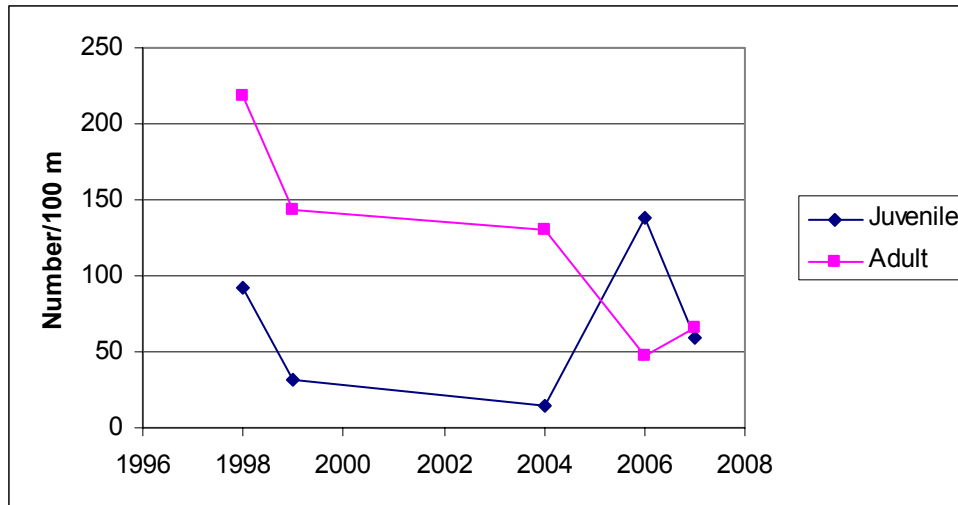


Figure 8. Trends in number of juvenile and adult brown trout per 100 m within site 5 in Spearfish Creek.

Cleopatra Creek

Cleopatra Creek is a small tributary that enters Spearfish Creek about 15 m above site number 4 (Figure 3). The lower boundary of the sample site on Cleopatra Creek is about 15 m upstream of the confluence with Spearfish Creek. This site on Cleopatra Creek has not been sampled since 1997 rendering it impossible to examine trend data.

Brook trout, brown trout, and rainbow trout were sampled in this reach of Cleopatra Creek. However, the samples were dominated by juvenile fish (< 200 mm) with few adults being sampled (Table 1). The disparity in the numbers of adult and juvenile fish may indicate that Cleopatra Creek may serve as important spawning and nursery habitat, especially for brook and rainbow trout. Results of this sampling appear to corroborate results of a radio telemetry study conducted by South Dakota Game, Fish, and Parks that indicated rainbow trout migrated relatively long distances in Spearfish Creek to spawn in Cleopatra Creek (James 2007).

The importance of Cleopatra Creek to the Spearfish Creek fishery is not completely understood, but it does appear the habitat within the creek is important to early life stages of brook and rainbow trout. Drought may be affecting the habitat within Cleopatra Creek which may be negatively impacting populations within Spearfish Creek. Further investigation is necessary to determine Cleopatra Creek's importance especially for brown trout. Data is lacking on spawning activity of brown trout within the Spearfish Creek Watershed.

Table 1. Population estimates in number of fish per 100 m of stream and number of fish per surface acre of water for Cleopatra Creek in the Spearfish Creek watershed.

Species	Size	Number/100 m	Number/ac
Brook trout	< 200 mm	267	3,034
Brook trout	≥ 200 mm	3	34
Brown trout	< 200 mm	4	45
Brown trout	≥ 200 mm	0	0
Rainbow trout	< 200 mm	124	1,409
Rainbow trout	≥ 200 mm	1	11

Recommendations:

1. Continue to monitor populations within the Spearfish Creek on a bi-annual basis.
2. Increase sampling efforts to a minimum of 30 sample reaches every other year, thereby decreasing variance by increasing sample size.
3. Monitor relative abundance of salmonids in the smaller tributaries every 3-5 years.
4. Investigate spawning activities of brown and rainbow trout to better understand timing of spawning movement and the possible utility of tributaries as spawning habitat.
5. Investigate the need to increase sample site length to sample sites are representative of Spearfish Creek and habitat variability is being captured.